Educational Psychology, Vol. 23, No. 2, 2003

Carfax Publishing
Taylor & Francis Group

Dual Scaling Analysis of Chinese Students' Conceptions of Learning

JOHN SACHS & CAROL CHAN, *Faculty of Education, The University of Hong Kong, Hong Kong SAR, China*

ABSTRACT *In this study, a descriptive quantitative methodology for categorical data analysis that works well with small samples was used to investigate whether Chinese students' conceptions of learning included memorisation as an integral part of understanding, as suggested by phenomenographic studies. Twenty-five Chinese students attending the B.Ed. programme at the University of Hong Kong were asked to rank order six conceptions of learning. Results revealed an interesting multidimensional structure, suggesting that memorising was seen as clearly distinct from knowledge and understanding. Contrasting conceptions of learning (such as memorisation vs changing as a person) were identified, similar to the previous distinction made between conceptions lacking, or being concerned with, constitutive meaning. These findings suggest multidimensional aspects to conceptions of learning for Chinese students that extend the notion of memorisation–understanding relations. Further inquiry in the areas of context, awareness, and types of memorisation would shed light on Chinese students' conceptions of learning. It is suggested that quantitative methodologies ideally suited to categorical data analysis with small samples could be used to supplement the results of qualitative phenomenographic methodologies on student conceptions of learning.*

Considerable research interest in education has been given to investigating students' conceptions of learning using the phenomenographic approach (Marton & Booth, 1997; Pramling, 1983; Prosser, Trigwell, & Taylor, 1994). In an often-cited study on students' conceptions of learning, Marton, Dall'Alba, and Beaty (1993) identified six salient views that Western students hold of learning:

- increasing one's knowledge (that is, accumulating information)
- memorizing and reproducing (that is, recalling important facts)
- applying (that is, using what one has learned)
- understanding (that is, focusing on ideas, gaining insight, and so on)

ISSN 0144-3410 print; ISSN 1469-046X online/03/020181-13 © 2003 Taylor & Francis Ltd
DOI: 10.1080/0144341032000039565

- seeing something in a different way (that is, seeing things from different perspectives)
- changing as a person (that is, growing as a person)

These conceptions of learning have also been divided into two distinct groups based on their conceptual similarity. Parallel to the surface/deep distinction examined in approaches to learning (Marton & Booth, 1997; Marton & Säljö, 1976), the first three conceptions were seen as lacking in constitutive meaning, while the last three conceptions were seen as being concerned with constitutive meaning. The key difference between the two categories is the focus of meaning in learning. Cross-cultural research using interview methods has shown that these six conceptions could be observed among Australian and Japanese students, with the former focusing more on school knowledge and the latter emphasising lifelong processes of learning (Purdie, Hattie, & Douglas, 1996).

Another important area of cross-cultural research with regard to students' conceptions of learning has centred on understanding the conceptions of learning that students from Confucian-heritage cultures (CHC) hold (Biggs & Watkins, 1996). Of particular interest has been the so-called "Chinese Learner" paradox (Watkins & Biggs, 1996). It is now well known that Chinese students, compared to their Western counterparts, have continually shown high achievement in mathematics and science in international studies of educational achievement, such as those conducted by the International Association for the Evaluation of Educational Achievement (IEA; see Biggs, 1996). Questions have been raised as to how Chinese students, often perceived by Western educators as passive learners, could perform so well on these international achievement tests despite the crowded and unfavourable learning environment (Biggs, 1996). Apparently, sociocultural factors such as cultural beliefs and parental expectations, and socioeconomic structures may explain the performance differences. Other factors related to learning have also been proposed—for example, Chinese learners are more adaptive and attuned to contextual factors and so they adapt their learning to fit their environment (Biggs, 1996).

Referring to Chinese students' conceptions of learning, Marton, Dall'Abla, and Tse (1996) argued that the "memorisation-understanding" relations observed among Chinese learners address this paradox. Whereas memorisation in Western countries is associated with rote learning and a lack of understanding, memorisation in Asian countries is seen not in terms of rote learning but rather as an integral component of understanding. These researchers argued that Chinese learners do not see memorisation as rote learning: rather, they would use understanding to help them memorise the materials. As well, due to the emphasis in traditional Chinese education on recitation, students would also memorise the materials to help themselves understand. Phenomenographic research has shown that students' conceptions of learning involve different levels of memorisation and understanding among Chinese secondary school students in Hong Kong (Marton, Watkins, & Tang, 1997).

More recently, a qualitative study conducted by Dahlin and Watkins (2000) contrasted German and Chinese secondary students' conceptions of memorising and understanding. Dahlin and Watkins' findings tend to support the idea that Asian students, in contrast to Western students, view memorisation as an integral component of understanding.

Although considerable interest has been given to Chinese students' conceptions of learning (Watkins & Biggs, 1996), not much empirical research has been conducted to

examine the idea of the Chinese learner. The few studies in the literature primarily employed phenomenographic methods to identify students' conceptions of learning (Dahlin & Watkins, 2000; Marton et al., 1996; Marton et al., 1997). Some quantitative studies on conceptions of learning in Asian students have been conducted (Meyer & Boulton-Lewis, 1999, Meyer & Kiley, 1998). And a recent quantitative study by Meyer (2000) has examined Australian students' conceptions of contrasting forms of memorisation. These quantitative studies, however, have relied on the large sample sizes needed for inferential statistical analyses. In contrast, our goal was to use a methodology for the analysis of categorical data that was suitable for the small samples commonly encountered in qualitative research studies, so as to investigate how Chinese students viewed the relations between memorisation and understanding, and more generally to investigate their views of differing conceptions of learning.

First, if in fact, Chinese students view memorisation as integral to developing understanding, then one would expect that two of the conceptions would be seen by them as similar: memorising and reproducing, and understanding what one has learned. A simple rank-ordering task and dual scaling methodology (Nishisato, 1980, 1984, 1994) were employed to examine students' views on conceptions of learning. Specifically, the first objective of the study was to investigate if the memorisation-understanding conjecture was supported by student ranking data.

Second, because the phenomenographic qualitative studies on students' conceptions of learning such as those conducted by Marton et al. (1993, 1996) have not been followed by any quantitative data analysis methods to explore the complex nature of students' conceptions of learning, a second objective of this study was to show how dual scaling methodology could be used to collect quantitative data to test conjectures based on qualitative research findings.

Method

Participants

Twenty-five participants registered in a module on education research at the University of Hong Kong took part in this study. All participants were local Hong Kong Chinese in their final year of B.Ed. study. Their ages ranged from 23 to 26, and 22 of the participants were female.

Measures

The wording of the six statements of students' conceptions of learning from Marton et al. (1996) was slightly modified for the purposes of this study, so as to make their meaning clearer to the participants. The following modified statements were used:

A. Increasing one's knowledge
B. Memorising and reproducing important facts
C. Applying what one has learned
D. Understanding what one has learned
E. Seeing something in a different way
F. Changing as a person

Procedure

At the end of the standard one-hour module feedback session, participants were asked to perform a simple rank ordering of the six conceptions of learning listed above. Participants were instructed to rank order the statements in terms of which they considered to be the most important in describing learning. They were to use the rank 1 for most important, 2 for second most important, and so on up to the rank of 6 for least important. The only condition imposed on the ranking task was that separate ranks be used for each statement. That is, tied ranks were not permitted. The six statements were presented to participants in a randomised order.

Data Analysis

The data was analysed with dual scaling (Nishisato, 1980, 1994), which is sometimes referred to as correspondence analysis (Greenacre, 1984). This method of analysis is basically a principal component analysis of categorical data (Jolliffe, 1986) and is ideally suited to the analysis of a variety of categorical data, including: contingency/frequency, multiple choice, paired comparison, rank order, rating, and sorting data. Furthermore, dual scaling is an exploratory methodology that does not involve any statistical model or distributional assumptions, and can be used with relatively small samples to reveal important patterns in such data (Nishisato, 1979).

Dual scaling is a well known method for the analysis of categorical data that can trace its origins to the early work of Richardson and Kuder (1933) and Guttman (1941) among others (see Nishisato, 1980, for a detailed discussion). Although a theoretical formulation of dual scaling involves the extensive use of matrix algebra (McDonald, Torii, & Nishisato, 1979; Nishisato, 1979, 1980, 1981, 1996; Nishisato & Arri, 1975; Nishisato & Sheu, 1980, 1984), its application and interpretation are relatively straightforward so that numerous applied studies using dual scaling can be found in the literature (Cheung & Mooi, 1994; Lostia & Guicciardi, 1995; Nishida & Nomura, 1994; Nomura & Nishida, 1992; Sachs & Lee, 1993; Saito, 1994, 1996; Suda, 1995; Toyoda & Maeda, 1994; Ueda, 1988; Yamauchi, 1989, 1990, 1991, 1993).

Since dual scaling can be used with a variety of data collection methods, a choice had to be made for this study between the use of rank ordering to collect responses over either paired comparison or the simple Likert rating method.

Weingarden and Nishisato (1986) found that the paired comparison method of rank ordering often resulted in respondents making inconsistent or intransitive judgements, resulting in confounding effects when the data were analysed. And since they found that the method of rank ordering provided better fit to the ordering of the five proposed brand names used in their own study. Weingarden and Nishisato recommend the general use of rank ordering over paired comparison.

Although dual scaling analysis of simple rating data using a Likert scale can arrange stimuli in a sequential order on a continuum, complete with category boundaries (Nishisato & Nishisato, 1984), this method of collecting responses was not used here because it could give only a unidimensional solution of participants' preferences. In that case, any multidimensional pattern in the data could not have been explored.

Results

The rank-order data collected in this study in shown in Table I. Dual scaling analysis of this data matrix using Dual3 (Nishisato & Nishisato, 1986) extracted three solutions,

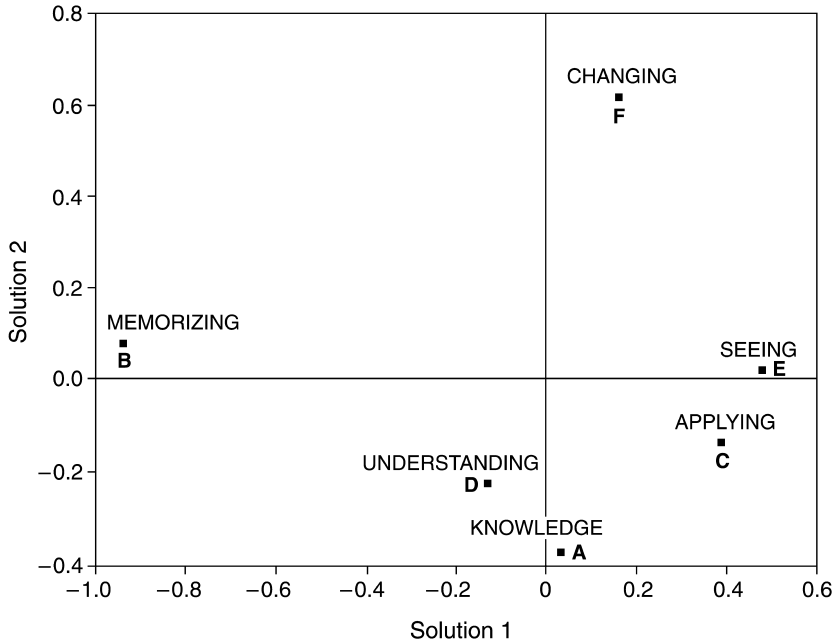

FIG. 1. Dual scaling Solutions 1 and 2 for the six conceptions of learning

which accounted for 46.4%, 21.4%, and 14% of the variance respectively: a total of almost 82% of the variance in the data. For each dual scaling solution, two sets of weights were obtained: participant weights and stimulus weights. The stimulus weights were the weights obtained for the six conceptions of learning statements (see bottom of Table I) used in the rank-order task. These weights are plotted in a series of two-dimensional plots shown in Figs 1 and 2.

Each dual scaling solution shown in these figures is interpreted by projecting the stimulus points onto the axis for that solution, thus obtaining a rank ordering of the conceptions of learning on the solution. For example in Fig. 1, the rank ordering of the conceptions of learning on Solution 1 is B (memorising and reproducing important facts) with a large negative value, followed some distance away by conceptions D (understanding what one has learned). A (increasing one's knowledge) and F (changing as a person) which have values near 0, thus showing that they occupying a more neutral position near the centre of Solution 1. Conceptions C (applying what one has learned) and E (seeing something in a different way) show larger positive weights on Solution 1; thus this solution would seem to contrast B (memorising) with C (applying what one has learned) and E (seeing things in a different way). Although participant weights are not shown due to space limitations, inspection of the participant weights showed that participants had a strong preference for conceptions C (applying) and F (changing) and basically no preference for conception B (memorising).

On Solution 2, conceptions E (seeing), B, (memorising), and C (applying) have values near 0, while conception F (changing) has a large positive weight, and concep-

TABLE I. Ranking of the six conceptions of learning

	Conception of learning					
participants	A	B	C	D	E	F
1	4	6	1	5	2	3
2	4	6	1	5	3	2
3	1	5	3	4	2	6
4	1	4	2	5	6	3
5	5	6	3	4	2	1
6	3	6	5	4	2	1
7	3	6	1	5	4	2
8	1	6	3	4	2	5
9	5	6	2	3	1	4
10	2	6	4	5	1	3
11	4	6	1	2	3	5
12	2	6	3	5	1	4
13	4	6	1	2	3	5
14	4	6	3	5	1	2
15	5	6	3	4	2	1
16	5	6	4	2	1	3
17	4	6	2	3	5	1
18	5	6	2	3	1	4
19	1	6	3	2	4	5
20	2	6	4	5	3	1
21	1	6	4	2	3	5
22	3	5	2	4	1	6
23	5	6	3	4	2	1
24	3	6	2	1	4	5
25	2	6	1	5	4	3

A = increasing one's knowledge; B = memorising and reproducing important facts; C = applying what one has learned; D = understanding what one has learned; E = seeing something in a different way; F = changing as a person.

tion D (understanding) followed by conception A (knowledge) have the largest negative weights. Participant weights for Solution 2 showed that on this dimension, seven participants had a strong preference for conception F (changing as a person), and seven participants had a strong preference for conception A (increasing one's knowledge) followed by D (understanding what one has learned), with the other participants having weights in between these two extremes. Thus Solution 2 is mainly a contrast of those participants that value changing as a person and those that value increasing one's knowledge as learning outcomes.

Taking the two-dimensional plot in Fig. 1 as a whole, we see that conceptions D (understanding) and A (knowledge) cluster together, as do conceptions E (seeing) and C (applying), suggesting that the conceptions of learning within each cluster are seen as more similar by the respondents, while conceptions B (memorising) and F (changing) are isolated at different ends of the plot and thus seen as clearly distinct.

Solution 3 stimulus weights are plotted against Solution 1 stimulus weights in Fig. 2. Projection of the stimulus points onto the Solution 3 axis shows that conceptions B (memorizing), C (applying), and F (changing) occupy the centre position on this solution, too, while conception A (knowledge) which has a large positive weight, is

TABLE II. Conceptions of learning defining each dual scaling solution

	Positive weights	*Negative weights*
Solution 1	Seeing something in a different way; applying what one has learned	Memorising and reproducing important facts
Solution 2	Changing as a person	Increasing one's knowledge
Solution 3	Increasing one's knowledge	Seeing something in a different way; understanding what one has learned

contrasted against conceptions D (understanding) and E (seeing) which have larger negative weights. Inspection of participant weights for this solution showed that four participants had a strong preference for conception A and three participants showed a strong preference for conceptions D and E, while the rest had weights between these two extremes. Clearly, then, Solution 3 is defined by those participants that value learning outcomes that lead to an increase in knowledge and those participants that value learning outcomes that lead to an increase in understanding, and being able to see things in a new or different way.

Only A (knowledge), F (changing), and C (applying) form a loose cluster in the upper right quadrant for the two-dimensional plot, suggesting some perceived similarity between these three conceptions of learning, while B (memorising). D (understanding), and E (seeing) are isolated in other parts of the plot indicating their perceived relative uniqueness.

A two-dimensional plot of Solution 2 against Solution 3 is not shown because of space limitations and because it added little to the interpretation of either Solution 2 or Solution 3. However, to aid the reader, the results that characterise each dual scaling solution have been summarised in Table 2. The conceptions of learning with the largest positive and negative weights previously indicated as defining each solution are presented there.

Discussion

This study examined Chinese students' views of differing conceptions of learning using quantitative categorical data analysis. The most striking feature of these results is that memorisation and reproducing, or recalling facts, was perceived as least important for these participants on the first dual scaling solution, which accounted for the most variance in the data. Dual scaling solutions also show that memorising is clearly distinct from understanding—they are a considerable distance apart on the scale. Such findings would seem to question Marton et al.'s (1996) argument that memorisation is experienced by the Asian learner as being in some way an integral part of understanding. Although the findings seem contradictory, the discrepancy between qualitative and quantitative data actually helped to elicit further insights into students' conceptions of learning. Three interpretations—context, awareness, and types of memorisation—are proposed that may shed light on Chinese students' conceptions of learning. Discrepancy and consistency with Marton et al.'s (1996) views on memory-understanding relations are also discussed.

First, memorisation and understanding may be perceived as distinct or integrally

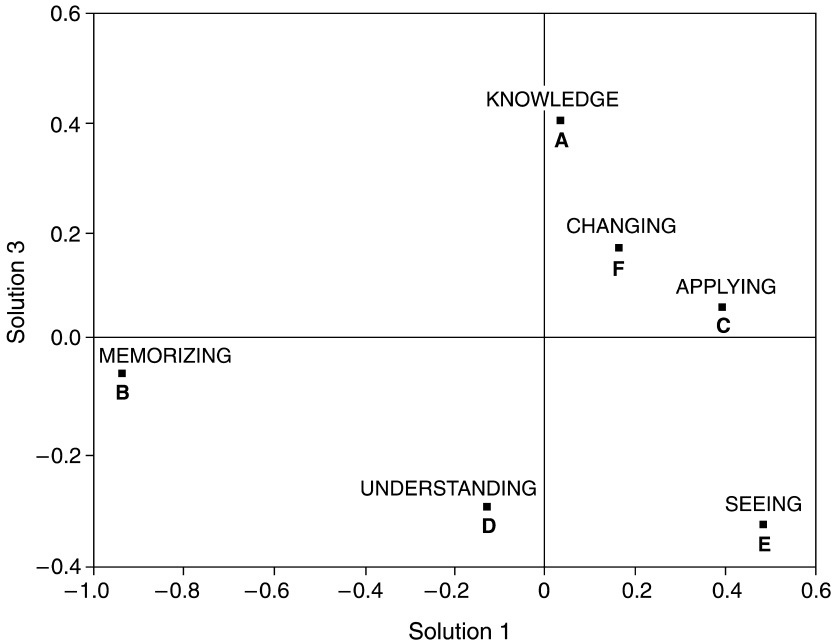

FIG. 2. Dual scaling Solutions 1 and 3 for the six conceptions of learning

related by Chinese students depending on the context. The present findings indicate that when asked directly to rank their conceptions, Chinese students did not see memorisation as important: rather, they saw it as distinct from understanding and increasing knowledge. On the other hand, interview findings have suggested that Chinese students see memorisation as integral to understanding. We argue that contextual factors would play an important role: specifically, interview research usually tackles questions in situ whereas questionnaire items are general. Chinese students may view memorisation-understanding as integrally related only in specific contexts, and not for learning in general.

These findings and interpretations thus shed light on the paradox of the Chinese learner. Memory-understanding relations are not intrinsic to the Chinese learner; they may develop and vary as a response to contextual demands. Hence, learners from other cultures could also experience memory-understanding in integral ways if the context demands such learning experiences. Apparently, emphasis on examinations in the school system in Hong Kong may elicit students' experience of memorisation-understanding more than in other regions. Such interpretations are consistent with the position arguing for the importance of examining contextual demands when addressing the paradox of the Chinese learner (Biggs, 1996). Future qualitative investigation in phenomenographic research could focus more on examining contexts and circumstances when memory-understanding relations are more, or less, salient in Chinese students' learning experiences. Similarly, quantitative research could include scenarios (Gaskell, Wright, & O'Muircheartaigh, 1993) to test in what contexts memorisation is seen as integral to understanding for Chinese students.

Second, the discrepancy between phenomenographic research and students' self-report data may be related to students' awareness of their own learning experiences.

Phenomenographic researchers examined students' conceptions of learning using probing questions and inferring memory-understanding relations based on the students' own perspectives (Marton et al., 1997). But when asked directly, students reported no similarities or relations between memorisation and understanding. Questions may be raised regarding the extent to which students are aware of their own learning experiences. Probing questions in phenomenographic interviews may help students to reflect on their learning experiences when they articulate their thoughts. Nevertheless, it is not clear whether Chinese students are generally aware of the intricate relations between memorisation and understanding that they experience in their learning. Could it be possible that students believe that memorisation is unimportant and distinct from understanding, even though they actually experience both processes in integral ways when they learn? Such conjectures need to be investigated further to examine Chinese students' reflective understanding. Further, if learning involves becoming aware of one's learning experiences (Marton & Booth, 1997) or becoming more metacognitive (Brown, Bransford, Ferrara, & Campione, 1983), and if memorisation is integral to understanding when learning in Chinese context, then there would be significant instructional implications for helping Chinese learners to become more aware of memory-understanding relations in their own learning.

Third, the discrepancy between qualitative findings and our ranking data may be related to types of memorisation—"mechanical memorisation" and "meaningful memorisation" (Marton et al., 1993). When the respondents were asked to do the ranking task, they had probably made a distinction between meaningless mechanical memorisation versus meaningful memorisation, and interpreted the questionnaire item on memorising and reproducing important facts as mechanical memorisation. The quantitative data could be seen as complementary to qualitative findings suggesting that two types of memorisation exist. It should be noted that the two kinds of memorisation are not unique to the Chinese learner and they have been observed in students from other cultures (Mugler & Landbeck, 2000). Nevertheless, the data did suggest that Chinese students could make a distinction between these two types of memorisation, and they did not see mechanical memorisation as important to learning or understanding.

These present quantitative findings also suggest other possibilities for the postulated memory-understanding relations identified in qualitative research. If students ranked mechanical or rote memorisation as unrelated to understanding, it would seem that the qualitative data on memory-understanding relations might pertain more to meaningful memorisation than to mechanical or rote memorisation. According to these ranking data, it does not follow that Chinese students actually believe that rote repetition (that is, memorising and reproducing) would eventually lead to meaningful understanding. It is much more likely that they see meaningful and active memorisation as related to understanding and learning. The two observed phenomena of understanding to facilitate memorisation, and rote memorisation to promote understanding, could be examined further. Qualitative interviews could examine more closely what students really meant when they said they repeated to understand. Quantitative methodology such as dual scaling may also be used to test these conjectures. Possibly two different kinds of memorisation (mechanical and active) may be included to examine how they were ranked; and their relative distances from understanding on the scale may help to clarify how respondents viewed the two different kinds of memorisation.

The other main findings from the dual scaling solutions showed the multidimensional aspects of the patterns of conceptions. Three sets of contrasting conceptions were identified that helped to define the three solutions (see Table II): Solution 1—

seeing something in a different way versus memorising; Solution 2—changing as a person versus increasing one's knowledge; and Solution 3—increasing one's knowledge and seeing something in different ways. These contrasting conceptions were similar to those identified by Marton et al. (1993) who distinguished two groups of conceptions with or without constituted meanings. Such findings are also consistent with research identifying distinctions between quantitative and qualitative conceptions (Biggs & Moore, 1993); and beliefs about learning based on transmission-constructivist distinctions (Bereiter & Scardamalia, 1989; Chan & Sachs, in press; Lonka, Joram, & Bryson, 1996). These findings indicate that, for the Chinese learner, there seem to be some contrasting notions between memorising and increasing one's knowledge versus seeing something in a different way and changing as a person.

As well as some similarities, differences were observed in these identified conceptions as compared to those postulated by Marton et al. (1993). Based on the phenomenographic tradition, the six conceptions identified by Marton et al. seemed to be of hierarchical structure with each higher level embedding the next lower level of conceptions. Our results do not show the distinctive grouping of the conceptions of learning into a D to F group characterised by constitution of meaning and an A to C group characterised by the lack of constitution of meaning. Rather, the grouping of these conceptions of learning has a more complicated multidimensional structure, as seen by inspecting Figs 1 and 2, than the simple linear structure proposed by Marton et al. (1993). For example, Solution 1 shows that applying and seeing different ways are close to each other although they were categorised into two different groups by Marton et al. The notion of applying what one has learned may have some different meanings for Chinese as compared to Western students. Furthermore, how different conceptions may be grouped together may also have different meanings for Chinese students.

Although our sample size was small, the participants in this study were fairly typical of Hong Kong B.Ed. students, and dual scaling is often used with small samples (Nishisato, 1984, 1994, 1996; Nishisato & Nishisato, 1984; Suda, 1995; Weingarden & Nishisato, 1986). Furthermore, one of our objectives was to promote the use of dual scaling to test conjectures that are often inferred from the results of qualitative research studies. Simple methods of quantifying qualitative data such as frequency counts, ranking, or rating of responses in a content analysis, yield categorical data that is amenable to dual scaling analysis. And since qualitative research is most often characterised by small sample sizes (Dahlin & Watkins, 2000; Marton et al., 1993), dual scaling analysis seems particularly appropriate whether existing qualitative data is quantified or whether categorical data is collected from the outset as was done here.

However, the fact that these respondents were B.Ed. students does make it possible that their conceptions of learning were influenced by their educational experiences at the university; and hence they ranked memorisation as unimportant. Future research should involve respondents from different backgrounds and should examine contrasting views of memorisation (Meyer, 2000). Additionally, both ranking and rating methods could have been used to show both multidimensional and linear ordering. Finally, some may argue that questionnaire data are limited because respondents may interpret the questions differently and cannot explain what they mean. Nevertheless, such quantitative data do provide an additional source of data for testing conjectures derived in qualitative research and for generating new hypotheses for further inquiry (Meyer, 2000; Meyer & Boulton-Lewis, 1999; Meyer & Kiley, 1998). Further studies of this type should consider using a larger number and variety of Chinese learners, along with an increased number of statements or constructed scenarios on Chinese learners'

conceptions of learning, so as to better reflect the rich variety of responses made by them and the multidimensional structure in these responses.

In summary, this study examined the notion of memorisation-understanding and the nature of conceptions of learning perceived by Chinese students, using quantitative methods. Memorisation was seen as unimportant and not integrally related to understanding. The discrepancy between quantitative findings and qualitative data point to three areas of inquiry involving context, awareness, and types of memorisation. Contrasting views of conceptions of learning were observed among these Chinese students that are consistent with the surface-deep dimension identified in other areas of research into conceptions of learning. Obviously, one should not over-generalise these results. However, they do suggest that the interrelationships between conceptions of learning that Chinese students hold seem more complicated than the qualitative research to date has shown; and quantitative methods need to be included to test the observed construct and to supplement qualitative research data in order to enrich our understanding of Chinese students' conceptions of learning.

Correspondence: Dr John Sachs, Department of Education, The University of Hong Kong, Pokfulam Road, Hong Kong SAR, China (e-mail: jsachs@hkucc.hku.hk).

REFERENCES

Bereiter, C., & Scardamalia, M. (1989). Intentional learning as a goal of instruction. In L.B. Resnick (Ed.), *Knowing, learning and instruction: Essays in honor of Robert Glaser* (pp. 361–392). Hillsdale. Erlbaum.

Biggs, J.B. (1996). Western misconceptions of the Confucian-heritage learning culture. In David A. Watkins & John B. Biggs (Eds.), *The Chinese learner: Cultural, psychological and contextual influences* (pp. 45–67). Hong Kong: The University of Hong Kong, Faculty of Education, Comparative Education Research Centre.

Biggs, J.B., & Moore, P.J. (1993). *The process of learning*. Sydney: Prentice Hall.

Biggs, J.B., & Watkins, (1996). The Chinese learner in retrospect. In David A. Watkins & John B Biggs (Eds.) *The Chinese learner: Cultural, psychological and contextual influences* (pp. 269–285). Hong Kong: The University of Hong Kong, Faculty of Education, Comparative Education Research Centre.

Brown, A.L., Bransford, J.D., Ferrara, R.A., & Campione, J. (1983). Learning, remembering, and understanding. In J.H. Flavell & E.M. Markman (Eds.), *Handbook of child psychology: Cognitive development* (4th ed., pp. 77–166). New York: John Wiley & Sons.

Chan, C.K.K., & Sachs, J. (2001). Beliefs about learning in children's understanding of science texts. *Contemporary Educational Psychology*, *26*, 192–210.

Cheung, K.C., & Mooi, L.C. (1994). A comparison between the rating scale model and dual scaling for Likert scales. *Applied Psychological Measurement*, *18*, 1–13.

Dahlin, B., & Watkins, D. (2000). The role of repetition in the process of memorization and understanding: A comparison of the views of German and Chinese secondary school students in Hong Kong. *British Journal of Educational Psychology*, *79*, 65–84.

Gaskell, G.D., Wright, D.B., & O'Muircheartaigh, C.A. (1993). Measuring scientific interest: The effect of knowledge questions on interest ratings. *Journal for the Public Understanding of Science*, *2*, 39–57.

Greenacre, M.J. (1984). *Theory and application of correspondence analysis*. New York: Academic Press.

Guttman, L. (1941). The quantification of a class of attributes: A theory and method of scale construction. In The Committee on Social Adjustment (Ed.), *The Prediction Of Personal Adjustment* (pp. 319–348). New York: Social Science Research Council.

Jolliffe, I.T. (1986). *Principal component analysis*. New York: Springer-Verlag.

Lonka, K., Joram, E., & Bryson, M. (1996). Conceptions of learning and knowledge: Does training make a difference? *Contemporary Educational Psychology*, *21*, 240–260.

Lostia, M., & Guicciardi, M. (1995). Motivational factors and aspects of success in the university setting: An exploratory study. *Bollettino di Psicologia Applicata*, *216*, 23–31.

Marton, F., & Booth, S.A. (1997). *Learning and awareness*. Mahwah: Lawrence Erlbaum Associates.
Marton, F., Dall'Alba, G., & Beaty, E. (1993). Conceptions of learning. *International Journal of Educational Research*, *19*, 277–300.
Marton, F., Dall'Alba, G., & Tse, L.K. (1996). Memorizing and understanding: The keys to the paradox? In D.A. Watkins & J.B. Biggs (Eds.), *The Chinese learner: Cultural, psychological and contextual influences* (pp. 69–83). Hong Kong: The University of Hong Kong, Faculty of Education, Comparative Education Research Centre.
Marton, F., & Säljö, R. (1976). On qualitative differences in learning 1—outcomes and process. *British Journal of Educational Psychology*, *46*, 4–11.
Marton, F., Watkins, D., & Tang, C. (1997). Discontinuities and continuities in the experience of learning: An interview study of high-school students in Hong Kong. *Learning and Instruction*, *7*, 21–48.
McDonald, R.P., Torii, Y., & Nishisato, S. (1979). Some results on proper eigenvalues and eigenvectors with applications to scaling. *Psychometrika*, *44*, 211–227.
Meyer, J.H.F. (2000). Variation in contrasting forms of 'memorising' and associated observables. *British Journal of Educational Psychology*, *70*, 163–176.
Meyer, J.H.F., & Boulton-Lewis, G.M. (1999). On the operationalisation of conceptions of learning in higher education and their association with students' knowledge and experiences of their learning. *Higher Education Research & Development*, *18*, 289–302.
Meyer, J.H.F., & Kiley, M. (1998). An exploration of Indonesian postgraduate students' conceptions of learning. *Journal of Further and Higher Education*, *22*, 287–298.
Mugler, F., & Landbeck, R. (2000). Learning, memorization, and understanding among distance learners in the South Pacific. *Learning and Instruction*, *10*, 179–202.
Nishida, K., & Nomura, Y. (1994). An evaluation of "now" (Japanese ima) in the process of cognition and solution of contradictory situations. *Japanese Journal of Psychology*, *65*, 150–155.
Nishisato, S. (1979). Dual scaling and its variants. *New Directions for Testing and Measurement*, *4*, 1–12.
Nishisato, S. (1980). *Analysis of categorical data: Dual scaling and its applications*. Toronto: University of Toronto Press.
Nishisato, S. (1981). Mathematical expositions of dual scaling. In Y.P. Chaubey & T.D. Dwivedi (Eds.), *Topics in applied statistics* (pp. 629–640). Montreal: Concordia University Press.
Nishisato, S. (1984). Forced classification: A simple application of a quantification method. *Psychometrika*, *49*, 25–36.
Nishisato, S. (1994). *Elements of dual scaling: An introduction to practical data analysis*. Hillsdale: Lawrence Erlbaum Associates.
Nishisato, S. (1996). Gleaning the field of dual scaling. *Psychometrika*, *61*, 559–599.
Nishisato, S., & Arri, P.S. (1975). Nonlinear programming approach to optimal scaling of partially ordered categories. *Psychometirka*, *40*, 525–548.
Nishisato, S., & Nishisato, I. (1984). *An introduction to dual scaling*. Toronto: MicroStats.
Nishisato, S., & Nishisato, I. (1986). *Dual3 Statistical Software Series*. Toronto: MicroStats.
Nishisato, S., & Sheu, W. (1980). Piecewise method of reciprocal averages for dual scaling of multiple-choice data. *Psychometrika*, *45*, 467–478.
Nishisato, S., & Sheu, W. (1984). A note on dual scaling of successive categories data. *Psychometrika*, *49*, 493–500.
Nomura, Y., & Nishida, K. (1992). An evaluation of the span and direction of spread of the concept "now" (Japanese ima): Using both dual scaling and factor analysis methods. *Japanese Journal of Psychology*, *63*, 133–139.
Pramling, I. (1983). *The child's conception of learning*. Göteborg: Acta Universitatis Gotheburgensis.
Prosser, M., Trigwell, K., & Taylor, P. (1994). A phenomenographic study of academics' conceptions of science learning and teaching. *Learning and Instruction*, *4*, 217–231.
Purdie, N., Hattie, J., & Douglas, G. (1996). Student conceptions of learning and their use of self-regulated learning strategies: A cross-cultural comparison. *Journal of Educational Psychology*, *88*, 87–100.
Richardson, M., & Kuder, G.F. (1933). Making a rating scale that measures. *Personnel Journal*, *12*, 36–40.
Sachs, J., & Lee, H.C.B. (1993). Dual scaling analysis of Rorschach responses in a Hong Kong Chinese sample. *Psychologia*, *35*, 84–95.
Saito, M. (1994). A cross-cultural study on color preference in three Asian cities: Comparison between Tokyo, Taipei, and Tianjin. *Japanese Psychological Research*, *36*, 219–232.
Saito, M. (1996). Comparative studies on color preference in Japan and other Asian regions, with special emphasis on the preference for white. *Color Research and Applications*, *21*, 35–49.

Suda, O. (1995). Dynamic systems of young children's behaviors organized in the process of emotion-regulation. *Japanese Journal of Developmental Psychology*, *6*, 48–57.

Toyoda, H., & Maeda, T. (1994). Analysis of high school teachers' views on the improvement of the university entrance examination: A method for content analysis of answers to essay form items. *Japanese Journal of Behaviormetrics*, *21*, 75–86.

Ueda, T. (1988). Sensitivity analysis in eigenvalue problems and its application to conditional ordinal data. *Behaviormetrika*, *23*, 93–109.

Watkins, D.A., & Biggs, J.B. (Eds.) (1996). *The Chinese learner: Cultural, psychological and contextual influences*. Hong Kong: The University of Hong Kong, Faculty of Education, Comparative Education Research Centre.

Weingarden, P., & Nishisato, S. (1986). Can a method of rank ordering reproduce paired comparisons? An analysis by dual scaling (correspondence analysis). *Canadian Journal of Marketing Research*, *5*, 11–18.

Yamauchi, H. (1989). Relationships between attributions and affective reactions to success and failure. *Psychologia*, *32*, 149–162.

Yamauchi, H. (1990). Actor and observer attributions by Japanese subjects for success and failure in noncompetitive situations. *Psychologia*, *33*, 212–219.

Yamauchi, H. (1991). Developmental study of moral judgments by Japanese children. *Psychological Reports*, *83*, 1131–1136.

Yamauchi, H. (1993). Work values of Japanese, Korean, and Chinese business workers. *Psychologia*, *36*, 25–258.